Computer Basics

Processors

The Processor

Processor Or CPU:

- The most important part, without which it is not a computer, or even a useful tool, is the central processing unit (CPU), also called the processor.
- But a CPU may not be the only processor in a PC. Other components may include a processor for performing the intense work of the component.
- The most common example of this is the graphics processing unit (GPU) found on modern video adapters, used to render the graphics images for the display.
- GPUs were integrated onto system boards along with the video adapter, and now there is a trend of integrating the GPU into some CPUs. Wherever it is located, the GPU saves the CPU for other system-wide functions and improves system performance

The Processor

CPU Purposes

- In a PC, the CPU is the primary control device for the entire computer system.
- The CPU is simply a chip containing a set of components that manages all theactivities and does much of the “heavy lifting” in a computer system.
- The CPU interfaces with, or connects to, all of the components such as memory, storage,and input/output (I/O) through busses.
- The CPU performs a number of individual or discrete functions that must work in harmony in order for the system to function.
- Additionally, the CPU is responsible for managing the activities of the entire system.

STEP 1

Fetch

The control unit fetches instructions from memory and places them into registers temporarily.

STEP 2

Decode

The control unit interprets the instructions and decides how to direct the ALU.

STEP 3

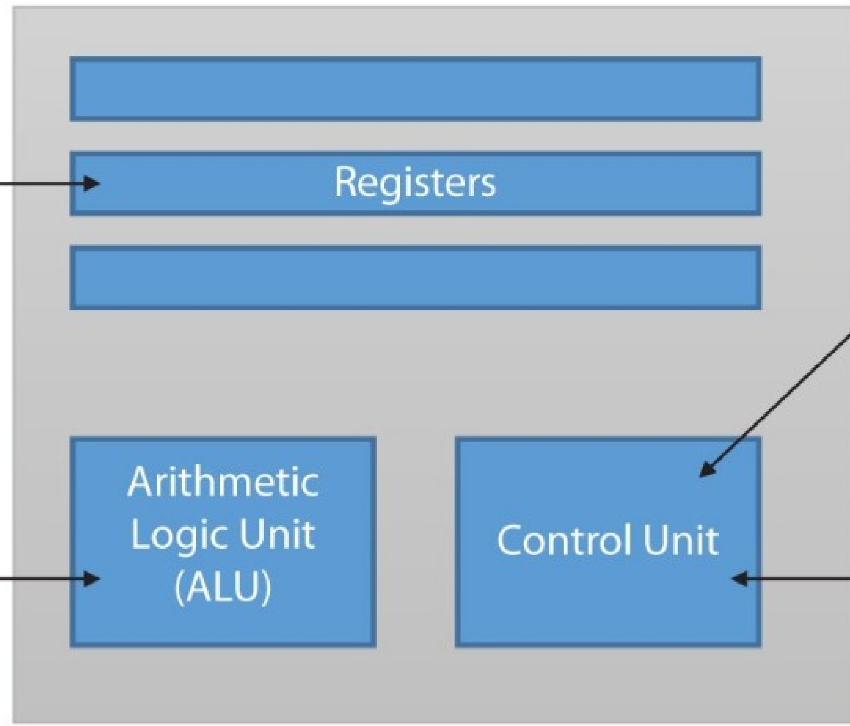
Execute

The ALU performs math calculations according to the instructions it receives.

STEP 4

Store

Processed data is stored in registers until the control unit gives an instruction for it to be output.



The Processor

Understanding Processor Terminology:

cover some basic terms that describe characteristics of different processors, past and present

1) Processor speed:

- Processor speed is how fast a processor executes its instructions or commands. second.
- A hertz is also known as a clock cycle, and a processor can execute code at every clock cycle. Thus, a processor operating at a measly 1 MHz per second can execute one million tasks every second.
- Processors today now measure their speed in gigahertz (GHz) per second.
- A gigahertz is one billion clock cycles per second — so the CPU can execute tasks a billion times per second!
- Original CPUs had a speed of 4.77 MHz, and systems at the time of this writing are running over 3.0 GHz. Although processor speed is not the only factor affecting This speed was originally measured in millions of hertz, or megahertz (MHz), per performance, in general, the faster the processor, the faster the system.

The Processor

Understanding Processor Terminology:

2) Data bus

- A city bus is responsible for transferring people from one location to another.
- In the world of computers, a bus is responsible for delivering data from one location on the PC to another. Data bus is the term used to define the pathway between the processor and memory. Because the processor accesses information from memory so often, an entire bus — the data bus — is dedicated to this action. The larger the data bus, the more data can be carried from the CPU to memory in one clock cycle.

The Processor

Understanding Processor Terminology:

2) Data bus

- Here’s an illustration. Say 50 people needed to go from one end of the city to theother, but a city bus had only 25 available seats.
- The solution? The bus would maketwo trips. Wouldn’t getting a larger bus be more efficient? If you upgradedthe bus to 50 seats, the bus would have to make only one trip to transfer the 50 people from one end of the city to the other, which increases the efficiency ofthe public transit system.
- The data bus works the same way, only it transfers data in the form of bits. A single bit is either a one or a zero. All data processed by the computer is in the form of bits. The data bus has a full capacity point at which it cannot handle anymore bits of data, just like the bus system in the city has a full capacity point(measured in seats).

The Processor

Understanding Processor Terminology:

2) Data bus

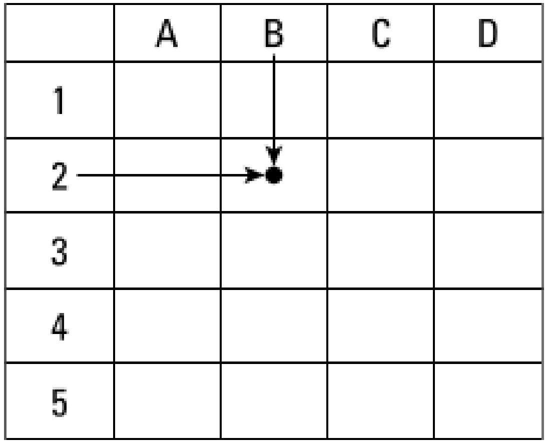
- If a processor has a 32-bit data bus, it can deliver — at most — 16 bits during a single clock cycle.
- If the same processor needs to deliver 64 bits of information, it has to take two trips: sending 32 bits during the first clock cycle and the remaining 32 bits during the next clock cycle.
- Taking that same 64 bits of information and processing it on a 64-bit processor means that the information will be delivered in one trip — one clock cycle, which increases the overall efficiency of the system.

The Processor

Understanding Processor Terminology:

3) Address bus

- To store information into system memory, your processor has to give an address that points to a particular storage location, only the address doesn't look like B2. It looks something like 10, or maybe 11, which are two completely different memory locations. As a result, the data would get stored in two different blocks.



The Processor

Understanding Processor Terminology:

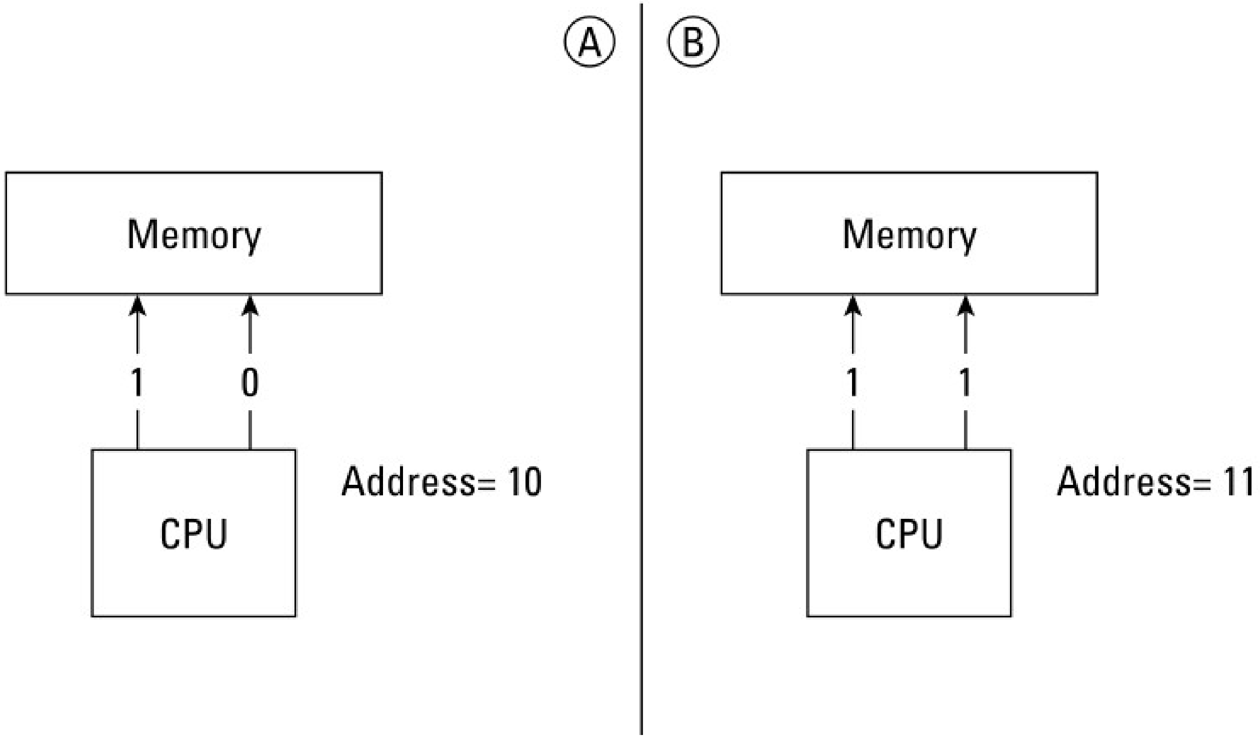
3) Address bus

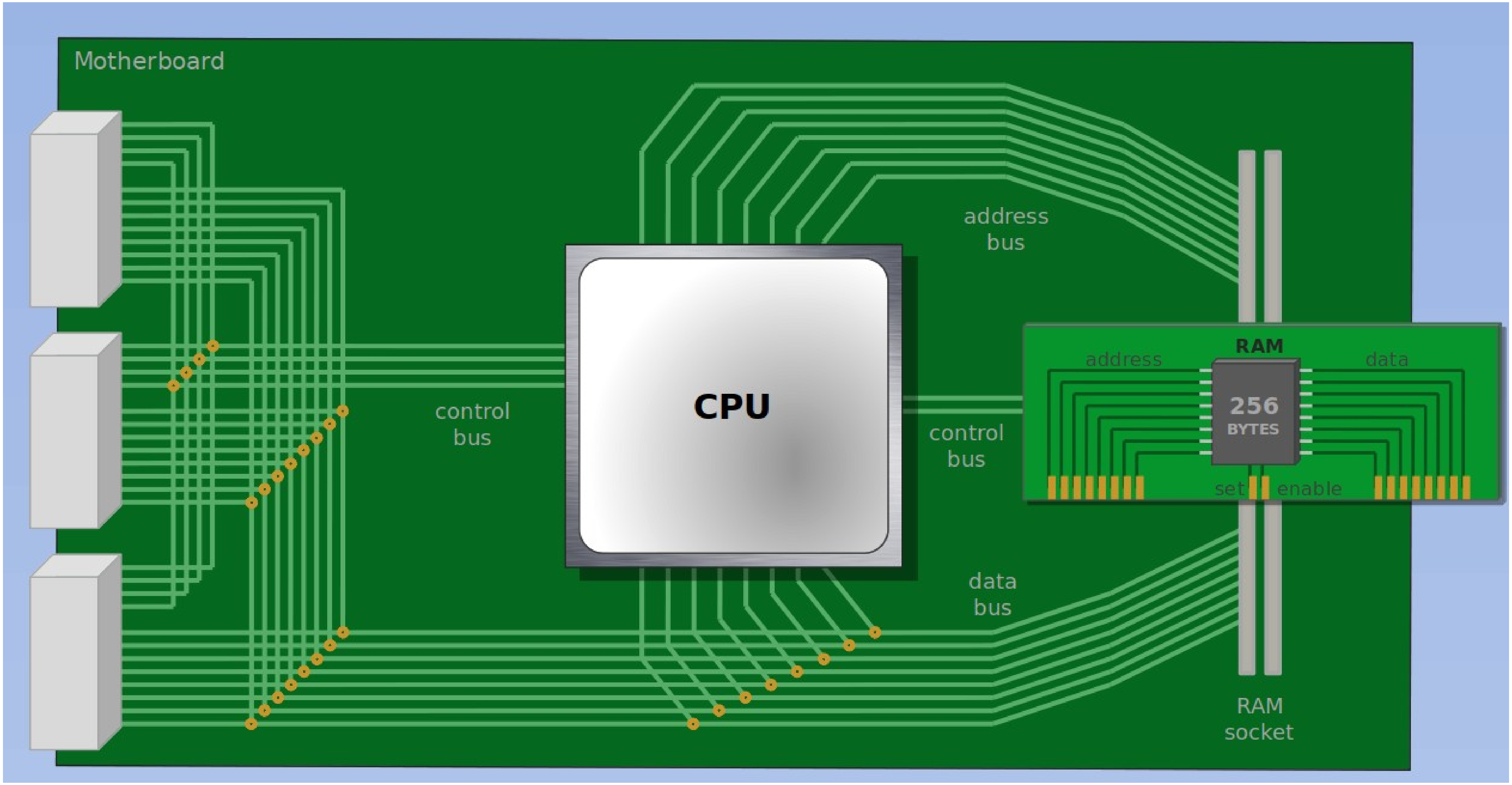
- Your processor accesses memory locations through the address bus.
- If, for example, the address bus is two-bit, the processor has two address lines from the processor to system memory. The address lines carry signals that specify locations in memory, each with an on/off state.
- A 1 represents an on state, and 0 represents an off state.
- The combination of the on/off states of both address lines at any given time is how a reference to an area in memory is made.
- The left side of the next Figure illustrates a processor making a reference — or call — to address 10.
- The right side of the figure shows a reference to address 11. These two address calls reference completely different locations in memory.

The Processor

Understanding Processor Terminology:

3) Address bus




Motherboard
address
bus
control
bus
CPU
control
bus
RAM
address
data
256
BYTES
set
enable
data
bus
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socket

The Processor

Understanding Processor Terminology:

3) Address bus

- If you add another address line to the address bus, the processor can access even more possible addresses because the processor has more variations with three bits than with two.
- A two-bit address bus can make a reference to four possible memory addresses (2 × 2), but a three-bit address bus can make a reference to eight possible memory addresses (2 × 2 × 2).
- Therefore, the address bus dictates how much physical memory the processor can access. For example, an old 80286 processor has a 24-bit address bus, which means that it can access 16,777,216 (2^{24}) memory addresses, or 16MB of system memory.
- A few years back, some processors had a 36-bit address buses, which allows them to access 68,719,476,736 memory addresses, or 64GB of memory.
- Newer processors are exceeding the 36-bit address bus, and one more example is a 40-bit address bus which allows for 1,099,511,627,776 addresses (or 1 TB of RAM)!

The Processor

Understanding Processor Terminology:

4) Registers

- Registers are storage areas within the processor used to store data temporarily for manipulation later. They are used to store and process data and perhaps write back the result of the processed data.
- The benefit of storing this information in the registers — instead of in memory — is that the processor contains the information and does not have to retrieve it from memory, which takes time.
- It is as if information to be processed were in your pocket, rather than across a room, where you would have to walk all the way over and pick it up. Having information in your pocket means it can be accessed much more quickly, saving time and increasing performance.

The Processor

Understanding Processor Terminology:

4) Registers

- Registers give a processor quicker access to data; the more registers a processor has, the more data it can store.
- Registers are measured in bits. A processor with 32-bit registers has 32 containers into which a programmer can choose to store information.
- Comparatively, a processor with 64-bit registers has twice as many containers that it can use to store information.
- There are two types of registers used in modern systems: dedicated registers and general-purpose registers.
  - Dedicated registers are usually for specific functions such as maintaining status or system-controlled counting operations.
  - General-purpose registers are for multiple purposes, typically when mathematical and comparison operations occur.

The Processor

Understanding Processor Terminology:

4) Cache memory

- The processor accesses information that resides in system memory, which is a slower process than if the information is stored in the processor's own special
- high-speed memory, known as cache memory. When the information is sitting in system memory and the processor sends a request for that information, the request goes to the memory controller, which manages data in memory.
- The memory controller finds the data in memory, retrieves it, and delivers it to the processor. Throughout this entire process, the processor is simply waiting around for the information. Thus, many newer processors include their own special high speed memory within the processor's chip.
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The Processor

Understanding Processor Terminology:

4) Cache memory

- When the processor retrieves information from slower system memory, it then stores it in the high-speed cache in case the processor wants to access the information a second time. The benefit is that the second time the data is needed, it is sitting in the high-speed memory located on the processor chip. The processor does not need to sit around and wait for the data to come from system memory — again, increasing overall performance.
- Cache memory is integrated right into the processor's chip and is made up of static RAM (SRAM). Cache memory is very expensive because it is much quicker than regular system memory. As a result of this extra memory being integrated into the processor chip, the processor becomes more expensive than a processor that has less or no cache memory.
- The three types of cache memory are Level 1 (L1) cache, Level 2 (L2) cache, and Level 3 (L3) cache. L1 cache is built into the processor, whereas L2 cache resides outside the processor.
- In the past, L2 cache resided on the motherboard, but newer processors have a bit of L1 and L2 cache for each core in the processor and then a shared block of L3 cache for all cores in the processor.

Thanks For Attention